REMARKS

Claims 1 and 20 have been cancelled. Claims 26 and 27 have been withdrawn. Claim 25 has been amended to correct an inadvertent typographical error. No new matter has been added. Claims 21-44 are present in the application; and claims 21-25 and 28-44 are active.

Restriction/Election Requirement

Applicants acknowledge the election of Group III, claims 21-44, for prosecution in the present application. Claims 1 and 20 have been cancelled without prejudice to their pursuit in a divisional application.

Applicants further acknowledge the election of the species including the electrolyte of claim 24, the fluorinated solvent of claim 29 and the surfactant of claim 31 for initial examination. Applicants respectfully disagree with the Office Action's assertion that no claim is generic, however. Independent claim 39 is generic for the electrolyte, the fluorinated solvent and the surfactant.

Claim Rejections

Delivery of fuel and oxidant to the electrodes of a fuel cell can be problematic. In a typical proton exchange membrane (PEM) fuel cell, the membrane can be dried out by a gaseous oxidant stream and/or a gaseous fuel stream. This can require special measures to be taken to keep the membrane hydrated and cool. The use of a liquid fuel in a PEM fuel cell can help maintain the hydration of the membrane, but typically leads to undesirable crossover of fuel to the cathode. In a laminar flow fuel cell without a PEM, it can be difficult to use oxygen as an oxidant. The oxidant is delivered to the cathode in a liquid that is proton conductive; however, oxygen has a low solubility in proton conductive liquids such as water and aqueous solutions of electrolytes.

The present invention includes a fuel cell comprising an emulsion comprising a fluorinated solvent, a surfactant and an aqueous electrolyte. An emulsion is a combination of at least two liquids, where one of the liquids is present in the form of droplets in the other liquid. IUPAC, *Compendium of Chemical Terminology: IUPAC Recommendations*, 2nd ed., compiled by A. D. McNaught and A. Wilkinson, Blackwell, Oxford (1997). The emulsion combines the gas transporting capabilities of fluorinated liquids with the charge conductivity of aqueous electrolytes, providing for improved liquid-phase delivery of a gas to an electrode.

Rejection under 35 U.S.C. § 103

The rejection of the claims as obvious under 35 U.S.C. § 103(a) over U.S. Patent Application Publication No. 2004/0058217 A1 (Ohlsen et al.) in view of U.S. Patent No. 5,185,218 (Brokman et al.) and DuPont Zonyl® FS-62 technical data sheet (Zonyl® FS-62) is respectfully traversed. Brokman et al. teaches away from an emulsion comprising a fluorinated solvent, a surfactant and an aqueous electrolyte, as recited in the active claims.

Brokman et al. discloses an air cathode for use in metal/air batteries and in hydrogen-oxygen fuel cells (col. 3, lines 5-8). An oxidant is supplied to the air cathode using "an oxygen-rich electrolyte-immiscible organic fluid" (col. 1, lines 63-66). This fluid is described as an oil such as a fluorinated hydrocarbon, or a non-halogenated oil such as silicone oil, mineral oil or a hydrocarbon (col. 2, lines 12-18). This fluid is pumped through a metallic mat, which serves as the air cathode (col. 3, lines 18-47). The fluid and an electrolyte are separated by a cathode catalyst and a waterproof barrier layer, which are present on one side of the metallic mat (col. 4, lines 21-43). The electrolyte is prevented from contacting the metallic mat and the fluid in order to avoid undesirable flooding and in order to maintain the three-phase boundary layer between oxygen, electrolyte and catalyst (col. 4, lines

36-43). There is no teaching in Brokman et al. of an emulsion of the oxygen-rich electrolyte-immiscible organic fluid with the electrolyte.

Ohlsen et al. discloses a microfluidic fuel cell in which a liquid fuel/electrolyte mixture and a liquid oxidant/electrolyte mixture flow between the anode and cathode by multistream laminar flow (para. [0020]). The liquid fuel/electrolyte mixture is in contact with the anode, and the liquid oxidant/electrolyte mixture is in contact with the cathode (FIG. 2 and para [0020]). In this laminar flow system, the two liquid mixtures flow together in a single channel, and the two liquids are in contact throughout the channel (para. [0021]). The laminar flow permits diffusive contact between the two liquid streams, allowing H^+ ions to diffuse between the anode and cathode (para [0021]).

Zonyl® FS-62 discloses an anionic fluorosurfactant that can be used in a variety of liquid systems.

Brokman et al. teaches away from an emulsion of a fluorinated solvent and an electrolyte. The electrolyte of Brokman et al. is prevented from contacting the metallic mat structure of the air cathode by a waterproof barrier layer. Since the metallic mat structure is the conduit through which the oxygen-rich electrolyte-immiscible organic fluid is pumped, the waterproof barrier layer also serves to prevent bulk contact between the fluid and the electrolyte. If the electrolyte were to contact the metallic mat and the fluid, undesirable flooding would occur, and the three-phase boundary layer between oxygen, electrolyte and catalyst would not be maintained. Thus, Brokman et al. teaches that the oxygen-rich electrolyte-immiscible organic fluid (which may be a fluorinated solvent) is to be kept separate from, and not combined with, the electrolyte. Accordingly, Brokman et al. teaches away from the present invention.

The active claims recite an emulsion comprising a fluorinated solvent, a surfactant and an aqueous electrolyte. Brokman et al. teaches away from the combination of a fluorinated solvent with an electrolyte, such as the electrolyte of Ohlsen et al. The combination of the references would not provide a fuel cell

comprising an emulsion comprising a fluorinated solvent, a surfactant and an aqueous electrolyte. Accordingly, the present invention is not obvious over the applied references. Applicants respectfully request that this rejection be withdrawn.

Rejection under 35 U.S.C. § 112

The rejection of the claims as indefinite under 35 U.S.C. § 112, 2nd paragraph is respectfully traversed. The Office Action asserts that it is unclear how a composition can be in contact with at least one of the anode and the cathode. Applicants respectfully point out that compositions in contact with an anode and/or cathode are described in the Specification. For example, FIG. 6 and the accompanying text at page 6, lines 12-26 of the Specification illustrate and describe such compositions. In this example, the composition from fuel input **22** is in contact with anode **30**, and the composition from oxidant input **24** is in contact with cathode **32**. Each of these compositions is in contact with at least one of the anode and the cathode. Thus, the phrase "a composition in contact with at least one of the anode and the cathode" is not indefinite. Applicants respectfully request that this rejection be withdrawn.

Claim Objection

The objection to claim 25 has been obviated by appropriate amendment. Claim 25 has been amended to recite a pH of "at least 10," rather than "at most 10".

CONCLUSION

All of the grounds raised in the present Office Action for rejecting the application are believed to be overcome or rendered moot based on the remarks above. Thus, it is respectfully submitted that all of the presently presented claims are in form for allowance, and such action is requested. Should the Examiner feel a discussion would expedite the prosecution of this application, the Examiner is kindly invited to contact the undersigned at (312) 876-1400.

Respectfully submitted,

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